A STUDY TO TEST EFFECTIVENESS OF MODIFICATIONS TO COD-FISHING POTS IN REDUCING CATCH RATES FOR TANNER CRAB *CHIONOECETES BAIRDI* AND MAINTAINING CATCH RATES FOR PACIFIC COD *GADUS MACROCEPHALUS*.

PHASE III: FIELD TRIALS IN 1998 AND 1999

by

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and David R. Jackson

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ALASKA DEPARTMENT OF FISH AND GAME
DIVISION OF COMMERCIAL FISHERIES

PROJECT OPERATIONAL PLAN

Title: A study to test effectiveness of modifications to cod-fishing pots in reducing catch rates for Tanner crab *Chionoecetes bairdi* and maintaining catch rates for Pacific cod *Gadus macrocephalus*. Phase III: Field trials in 1998 and 1999.

Yellow Book Project No(s):	SP-652 (Appendix A)	
Project Leaders:	Dave Jackson Leslie Watson	**PCN:** 11-1036 **PCN:** 11-1428
Biometrician:	Douglas Pengilly	**PCN:** 11-1202
Date Submitted:	September 1998	
Region:	Westward	
Fishery Unit:	4400	
Fishery:	Kodiak Area Pacific Cod Pot Fishery	
Fishery Management Plan:	Kodiak Area Pacific Cod Management Plan (5 AAC 28.467)	
File Name:	*D:\cod98III\popIII.doc*	

APPROVALS

Level	Signature	Date
Project Leader:	_____	_____
Biometrician:	_____	_____
Research Supervisor:	_____	_____
Regional Supervisor:	_____	_____
Headquarters' Receipt:	_____	_____
Headquarters' Recommendation:		
Further Review:	_____	_____
Approval:	_____	_____

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INTRODUCTION

Pot gear accounts for a large and increasing portion of the Tanner crab *Chionoecetes bairdi* bycatch in the Gulf of Alaska Pacific cod *Gadus macrocephalus* fishery. Estimated bycatch of Tanner crabs in the Gulf of Alaska cod pot fishery was 71,226 crabs during the 1996 season and 183,868 crabs during the 1997 season (NMFS 1998). Similarly, the percentages of the Pacific cod catch taken by pots has grown from 0% in 1984 to 22.5% in 1997 (NPFMC 1997). The need to develop crab-bycatch reduction measures in the cod pot fishery is indicated by the depressed status of affected crab stocks, expected effort increases in the pot fishery, and provisions in the Magnuson-Stevens Fishery Conservation and Management Act that place increased emphasis on reduction of incidental catch (NOAA 1997). In response, the Scientific and Statistical Committee of the North Pacific Fishery Management Council (NPFMC) has identified expanded research on gear modifications and other methods for reducing bycatch as its top research priority relative to bycatch problems. Fortunately, pots offer more design options for reducing bycatch than most other fishing gear (Miller 1996). In particular, testimony presented to the NPFMC in 1996 suggested that significant reductions in crab bycatch in the cod pot fishery could be effected by simple alterations to cod pots.

All known pot fishermen and manufacturers participating in Alaskan crab or cod fisheries were solicited in 1997 for ideas on alterations to standard cod pots that would reduce Tanner crab bycatch but maintain catch rates of cod. Three designs were chosen based on presumed effectiveness, on corroborative information supplied by designers, and on feasibility of the alterations for use in a commercial fishery (Watson et al. 1998a). All alterations chosen for study were designed to inhibit the entry of Tanner crabs into cod pots using a standard cod pot, i.e., a rectangular king crab pot with tunnel eyes modified for groundfish consistent with 5 AAC 28.050 (e) (ADF&G 1997). The three modification designs are depicted in Watson et al. (1998a) and were:

1. *False-tunnel.* A trapezoidal web panel attached to the lower edge of the tunnel eye, extending horizontally and parallel to the bottom of the pot and outward to the tunnel sides;

2. *Slick-ramp.* A trapezoidal panel of plastic attached flush to the tunnel ramp from the lower edge of the tunnel eye outward to the base of the tunnel and extending up the tunnel; and

3. *Vertical-board.* A pine board 1" x 8" x 6.5' installed lengthwise across the bottom of the tunnel, and flush with the bottom frame of the pot and the lower 8" of the pot frame sides.

Field trials comparing the three modified pots against the standard cod pot were conducted in November 1997 and March 1998 (Watson et al. 1998b and 1998c). Results from those trials indicated that the false-tunnel modification had the lowest bycatch of Tanner crabs per catch of Pacific cod of any of the modified pots (1.5 Tanner crabs per cod). Moreover, the false-tunnel pot outperformed the standard cod pot, which averaged 7.3 Tanner crabs per cod, despite the comparable overall catch rates of cod in those two pot types (Table 1).

This document provides the Project Operational Plan for continued field studies on the effectiveness of cod-pot modifications in Tanner crab bycatch reduction while maintaining catches of targeted

Pacific cod. This phase focuses on field trials of two new cod pot modifications and the false-tunnel pot against the standard cod pot to evaluate catch rates of Tanner crabs and Pacific cod.

OBJECTIVES

The objectives of this study are:

1. to solicit pot fishermen and pot manufacturers for cod pot alterations to "standard" cod pots designed to reduce Tanner crab bycatch;

2. to test and compare the effectiveness of those alterations in reducing Tanner crab bycatch; and

3. to report the results in a manner that is understandable to pot cod fishing industry and managers and can be incorporated as a tool to reduce unwanted bycatch of Tanner crab in the pot cod fishery.

METHODS

The study will be conducted in two parts. Tanner crab catch rates will be investigated in October 1998 whereas Pacific cod catch rates will be the focus in March 1999. However, catch rates of both Tanner crabs and cod will be enumerated and analyzed in both parts of the study.

Selection of Modifications for Testing

The false-tunnel pot performed best in the reduction of Tanner crab bycatch while maintaining catches of Pacific cod, and was selected on this basis for inclusion in this study. The second modification chosen for the study tests a modification in use by local fishermen (no-tunnel modification). The third design incorporates the no-tunnel modification and includes a vertical plastic panel to ostensibly prevent Tanner crabs from climbing up the sidewall to the tunnel entrance.

Pot Design and Modifications

Each of the three modified cod pots will be evaluated against the standard cod pot and each of the three modified pots will be fitted as standard cod pot prior to modification as described below.

Standard Cod Pot. A commercial size crab pot measuring 19.8 m x 19.8 m x 7.6 m (6½ ft x 6½ ft x 2½ ft), with 20.3 cm x 91.4 cm (8 in x 36 in) vertically-placed tunnel eye openings, cod

triggers or fingers and halibut excluder devices placed vertically in the tunnel eye every 22.9 cm (9 in) (Figure 1). Each pot is webbed with 7.6 cm (3 in) stretched mesh.

False-tunnel Modification. A standard cod pot fitted with a trapezoidal web panel attached to the lower edge of the tunnel eye, extending horizontally and parallel to the bottom of the pot, outward to the tunnel sides at a height of 25.4 cm (10 in) from the base of the pot (Figure 2).

No-tunnel Modification. A standard cod pot with the tunnel ramps removed and replaced with a vertical sidewall of web containing the tunnel eye placed directly below the top frame of the pot (Figure 3).

No-tunnel with Panel Modification. A 'no-tunnel' modified cod pot fitted with 2 mm x 25.4 cm x 19.8 m (1/13 in x 10 in x 6½ ft) rigid plastic attached flush to the vertical sidewall, from the lower edge of the tunnel eye to the base of the pot and extending to the edges of the vertical sidewall (Figure 4).

Comparison of Catch Rates

Catch rates of Tanner crabs in the modified pots will be compared to those in unmodified standard cod pots during October 1998 in an area of known Tanner crab concentrations within Chiniak Bay, Kodiak, Alaska. The charter vessel, F/V *Enterprise*, will be used to fish the study pots. Similarly, catch rates of Pacific cod in the modified pots will be compared to those in unmodified standard cod pots during March 1999 in known areas of Pacific cod concentrations in the Kupreanof Strait area of Kodiak Island. The ADF&G research vessel, R/V *Resolution*, will be used to fish the study pots.

Deployment, Baiting, and Soak Time of Pots

A total of 16 pots (four standard cod pots and four of each of the three modification types) will be fished concurrently. Each pot will be baited with two hanging net bags, each containing 2.2 kg (5 lb) of chopped frozen herring. The 16 pots will be set in four groupings of four pots each. Each group of four pots (quad) will consist of a standard pot and one of each of the three modification types. Pots in a quad will be set at the corners of a square with 0.24 km (0.13 nmi) sides. The arrangement by pot type within quads will be determined randomly and independently of other quads (Appendix B). The separate quads will be spaced a minimum of 0.93 km (0.5 nmi) apart and in any array (e.g., square, rectangle, line, or curved.) necessary to enable placement within concentrations of Tanner crabs (October 1998) and Pacific cod (March 1999). An example deployment of the 16 pots is provided in Figure 5.

All effort will be made to minimize differences in soak times of pots lifted on the same day within the same quad. Pots will be baited and reset following the constraints on deployment provided above. Target soak times will be 6 h, 18 h, and 24 h, however, soak times may exceed 24 h if poor weather delays gear retrieval.

A maximum of 10 d of pot-lifting is allotted for the October 1998 field trial and approximately 10 days of pot-lifting is scheduled for the March 1999 trial. Data on pot deployments (e.g., set locations, set time and date, and lift time and date) will be recorded by the vessel skipper in the Pilot House Log (Appendix C.1).

Catch Sampling and Data Recording

The following data will be recorded prior to releasing pot catches.

Catch Composition. Catch of all species (or species group) will be enumerated and recorded on the Species Composition Form (Appendix C.2). Daily examination of Tanner crab catch or Pacific cod catch on the Species Composition Form will allow for adjusting plans for soak times and number of pot-lift days within each of the field trials.

Additional data from any Tanner crab, king crab, or Pacific cod, will also be recorded as outlined below.

Tanner and King Crab Sampling. Tanner and king crabs will be enumerated separately from crabs captured inside the pot and (if any) crabs that were retained on the outside surface of the pot. Crabs will then be separated by species and sex and, if necessary for subsampling (see below), into sublegal males, legal males, juvenile females and adult females.

Sex, shell age, and carapace width (Tanner crabs) or carapace length (king crabs) will be recorded from each crab. Legal or sublegal status of male, juvenile or adult status of female Tanners, and reproductive condition of females will also be recorded. Crab data will be recorded on the Crab Data Form (Appendix C.3). Data from crabs retained on the outside of a pot will be recorded on a separate sheet from crabs captured inside the same pot.

Subsampling of crab catch from a pot for recording of data is to be avoided. Subsampling will be performed only if the crew leader (Watson) judges that the catch of a crab species is so numerous that whole-catch sampling would interfere with completion of the day's fishing goals. If subsampling of a species within a pot is desired, the following guidelines will be addressed: 1) the crab species will be divided into sublegal males, legal males, juvenile females, and adult females; 2) an appropriate sampling fraction will be estimated for each of those four sex-size groups (note that some or most of those groups may not need to be subsampled); 3) data from only one subsampled sex-size group will be recorded on any form; and, 4) the actual sampling fraction (number measured out of number captured) for the subsampled sex-size group will be determined and recorded on the Crab Data Form.

Pacific Cod Sampling. Pacific cod catches will be fully enumerated. Lengths (unsexed) of all captured Pacific cod will be recorded on the Fish Length Form (Appendix C.4). On a time-available basis, Pacific cod will be tagged and released as per D. Urban (ADF&G, Kodiak, Alaska, personal communication).

Underwater Video Camera Deployment

The newly acquired Bering Sea Crab Test Fishery Project underwater video camera will be used to document Tanner crab and cod behavior in and around each pot type. A short video will be prepared for the public, interested staff, and associated agencies depicting the catchability of the three modified pots and the standard pot. The camera assembly will be not be deployed in pots within test quads due to unknown effects of undersea lights on animal behavior. Rather, each pot type from an onboard spare quad will be fitted with the camera, and deployed singly, at a minimum distance of 0.5 nmi from the nearest test quad. Following dry land instruction from D. Tracy, the video camera will be operated as described in Appendix D.

Data Analysis

Although Tanner crab catch rates will be the focus of analysis in the October 1998 study and Pacific cod catch rates will be the focus of analysis in the March 1999 study, catch rates of both species will be compiled and analyzed during the entire study.

Statistical Tests for Significance of Variation in Tanner Crab and Pacific Cod Catch Rates Among Pot Types. Catch per pot or catch per unit effort (CPUE) of Tanner crabs and Pacific cod will be computed for each fished pot, including any Tanner crabs or cod retained on the outside of the pot. Catch per pot by pot type will be examined by soak time (e.g., 6 h, 18 h, 24 h, and other soak time groupings as needed) prior to performance of statistical tests to determine if any trends attributable to soak time may exist that would warrant blocking by soak time.

Tanner crab and Pacific cod CPUEs will be analyzed according to a repeated measure model in which the data from a single quad is treated as a four-variate random variable (with CPUEs of crab and cod for each of the four pot types as the four components of the random variable). Results for one quad will be assumed to not influence the results of any other quad (i.e., the four-variate random variables are assumed to be mutually independent). Pot types within each quad will be ranked from 1 (lowest CPUE for quad) to 4 (highest CPUE for quad).

For the October 1998 field trial, Friedman's test (Conover 1971) will be used to test the null hypothesis,

H_0: Each ranking of pot type by Tanner crab CPUE within a quad is equally likely,

against the alternative hypothesis,

H_1: At least one of the pot types tends to yield larger Tanner crab CPUEs than at least one other pot type.

For the March 1999 field trial, Friedman's test (Conover 1971) will be used to test the null hypothesis,

H_0: Each ranking of pot type by Pacific cod CPUE within a quad is equally likely,

against the alternative hypothesis,

H_1: At least one of the pot types tends to yield larger Pacific cod CPUEs than at least one other pot type.

Examination of Size Frequencies and Other Exploratory Data Examinations. Data summaries that may aid in interpretation of results of statistical tests or in formulating new hypotheses will be performed. Those data summaries will include, but may not be limited to the following:

For the October 1998 study:

1. CPUE of Tanner crabs by pot type will be summarized and compared for sublegal males, legal males, juvenile females, and adult females.

2. Carapace width frequency distributions for male and female Tanner crabs will be prepared for each pot type and compared.

3. Number (if any) of Tanner crabs retained outside of pots will be summarized by pot type and soak time.

For the March 1999 study:

1. CPUE of Pacific cod by pot type will be summarized and compared.

2. Length frequency distributions for unsexed Pacific cod will be prepared for each pot type and compared.

3. Number (if any) of Pacific cod retained outside of pots will be summarized by pot type and soak time.

SCHEDULES

October 1998

Date	Activity
October 1998	Organize all forms and supplies.
October 8	Load gear on FV Enterprise and set 16 baited pots in four quads of four pots each in Chinak Bay.
October 8-18	Set and retrieve gear.
October 18	Off-load pots from vessel.
October 18-31	Data edit, entry, and compilation.
November 1-15	Data analysis, results reported in a Regional Information Report.
May 30 1999	Project completion report; submit to North American Journal of Fishery Management.

March 1999

Date	Activity
February 1999	Organize all forms and supplies.
March 8	Load gear on RV Resolution and set 16 baited pots in four quads of four pots each in Kupreanof Strait.
March 8-18	Set and retrieve gear.
March 18	Off-load pots from vessel.
March 18-31	Data edit, entry, and compilation.
April 1-15	Data analysis, results reported in a Regional Information Report.
May 30 1999	Project completion report; submit to North American Journal of Fishery Management.

REPORTS

Watson L.J., D. Pengilly, and D.R. Jackson. 1998. Effects of modifications to cod-fishing pots in reducing catch rates of Tanner crabs *Chionoecetes bairdi*, 1998-1999 field trials. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 4K98-XX, Kodiak. Scheduled completion date: November 15, 1998.

Watson L.J., D. Pengilly, and D.R. Jackson. 1999. Effects of modifications to cod-fishing pots on catch rates of Pacific cod *Gadus macrocepahlus*, 1998-1999 field trials. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 4K99-XX, Kodiak. Scheduled completion date: April 15, 1999.

Watson L.J. and D. Pengilly. 1999. A gear study to reduce Tanner crab *Chionoecetes bairdi* bycatch in the Gulf of Alaska Pacific cod *Gadus macrocephalus* cod pot fishery. Submission to the North American Journal of Fishery Management. Scheduled completion date: May 30, 1999.

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Alaska Department of Fish and Game (ADF&G). 1997. 1997-1998 Groundfish fishery commercial fishing regulations. Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division, Juneau.

Conover, W.J. 1971. Practical nonparametric statistics. John Wiley and Sons Inc., New York.

Miller, R.J. 1996. Options for reducing bycatch in lobster and crab pots. *In*: Solving bycatch: considerations for today and tomorrow. Proceedings of the Solving Bycatch Workshop. Sea Grant College Program Report 96-03. University of Alaska, Fairbanks.

National Marine Fisheries Service (NMFS). 1998. 1997 *Bairdi* Tanner and red king crab bycatch by target fishery, zone and mode in the Gulf of Alaska, pot gear. NMFS Alaska Region Home Page, Juneau.

National Oceanic and Atmospheric Administration (NOAA). 1997. Magnuson-Stevens Act Provisions-National Standards Guidelines: 50 CFR Part 600. Department of Commerce. Federal Register (62)149: 41907-41920.

North Pacific Fishery Management Council (NPFMC). 1997. Stock assessment and fishery evaluation report on the groundfish resources of the Gulf of Alaska.

Watson, L.J., D. Pengilly, and D.R. Jackson. 1998a. Project operational plan: A study to test the effectiveness of modifications to cod-fishing pots in reducing catch rates for Tanner crabs *Chionoecetes bairdi* and maintaining catch rates for Pacific cod *Gadus macrocephalus*. Phase I: Tanner crab catch rates. Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division, Regional Information Report No. 4K98-1, Kodiak.

Watson, L.J., D. Pengilly, and D.R. Jackson. 1998b. Effects of modifications to cod-fishing pots in reducing catch rates for Tanner crab *Chionoecetes bairdi*. Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division, Regional Information Report No. 4K98-21, Kodiak.

Watson, L.J., D. Pengilly, and D.R. Jackson. 1998c. Effects of modifications to cod-fishing pots on catch rates of Pacific cod *Gadus macrocephalus*. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 4K98-45, Kodiak.

Table 1. Comparison of the bycatch of Tanner crabs in November 1997 with the catch of Pacific cod in March 1998 by pot type.

Pot Type	Tanner Crab Average CPUE[a]	Pacific Cod Average CPUE	Tanner Bycatch/ Pacific Cod Catch
Standard Cod Pot	116.1	15.9	7.3:1
False-tunnel Modification	27.5	18.4	1.5:1
Slick-ramp Modification	63.6	10.8	5.9:1
Vertical-board Modification	18.0	0.7	25.7:1

[a] Catch per unit effort.

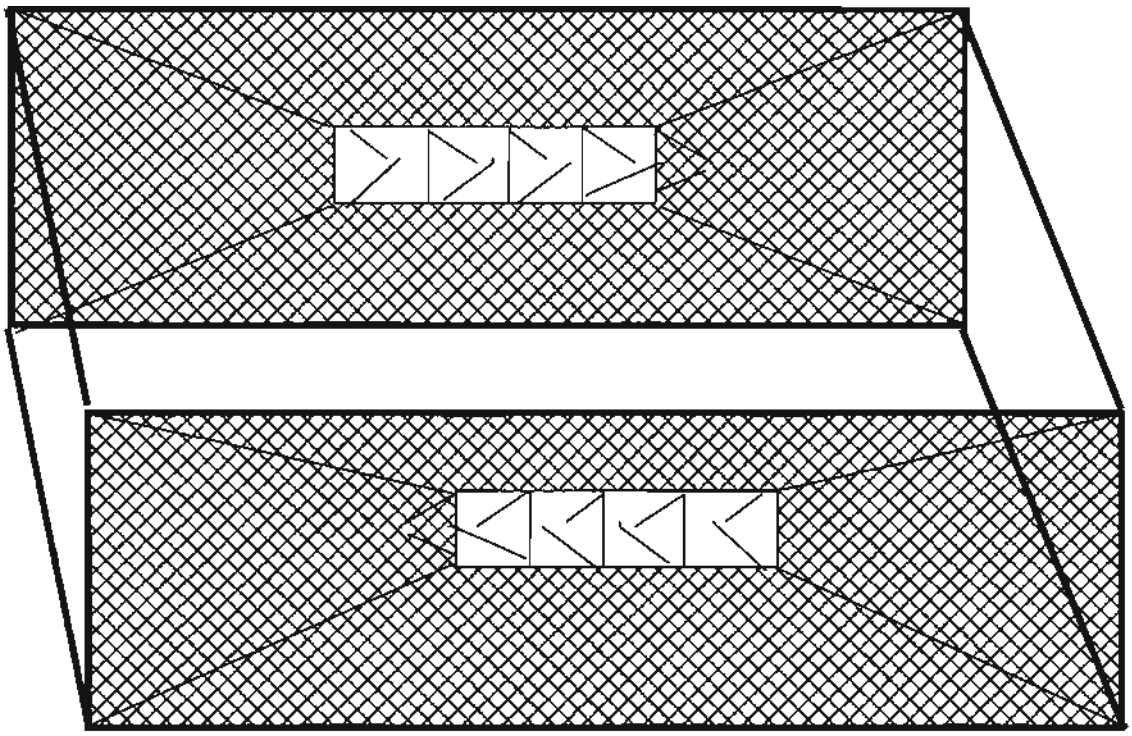

Figure 1. Standard cod pot with cod triggers and vertical halibut excluders installed in each tunnel eye.

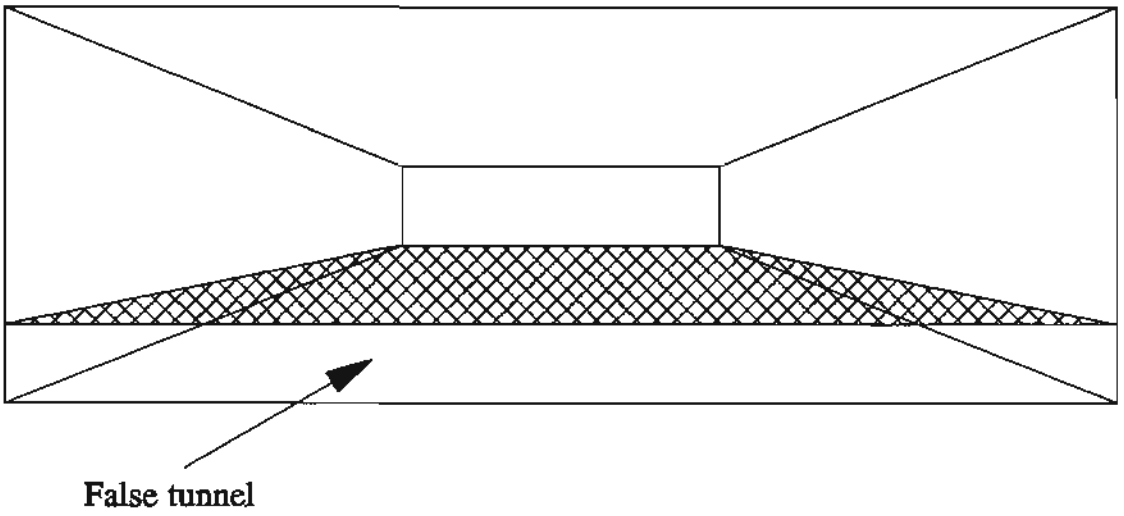

Figure 2. False-tunnel modification to a standard cod pot. Installed cod triggers and halibut excluders are not shown.

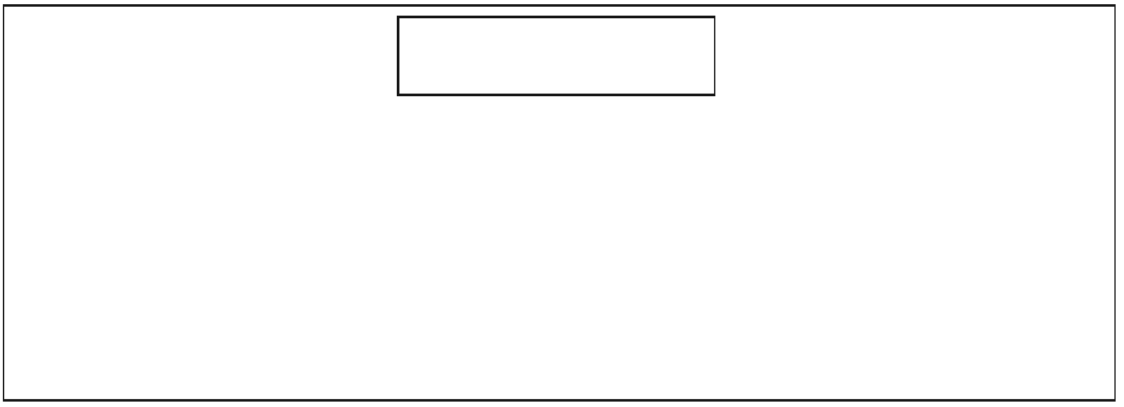

Figure 3. No-tunnel modification to a standard cod pot. Installed cod triggers and halibut excluders are not shown.

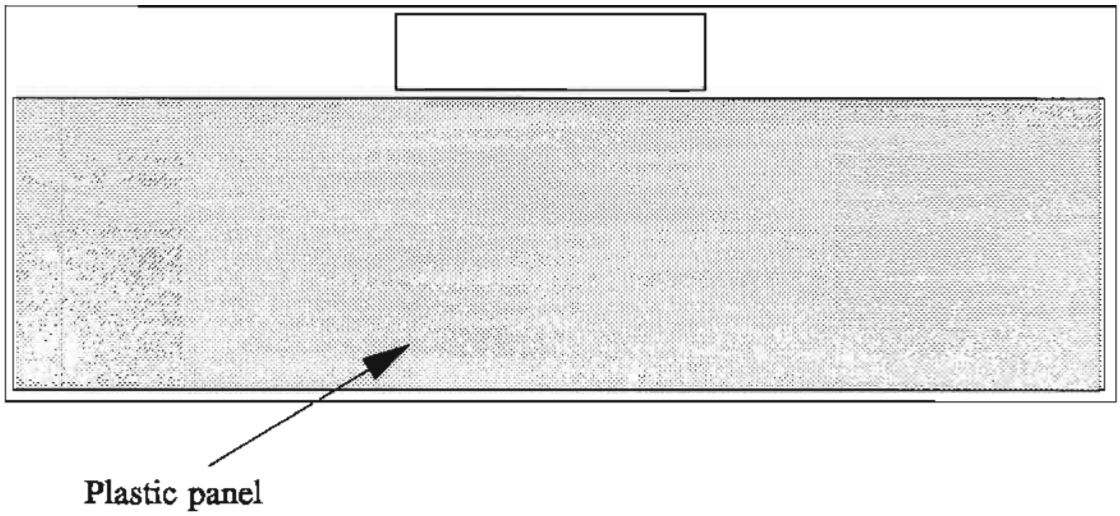

Figure 4. No-tunnel with panel modification to a standard cod pot. Installed cod triggers and halibut excluders are not shown.

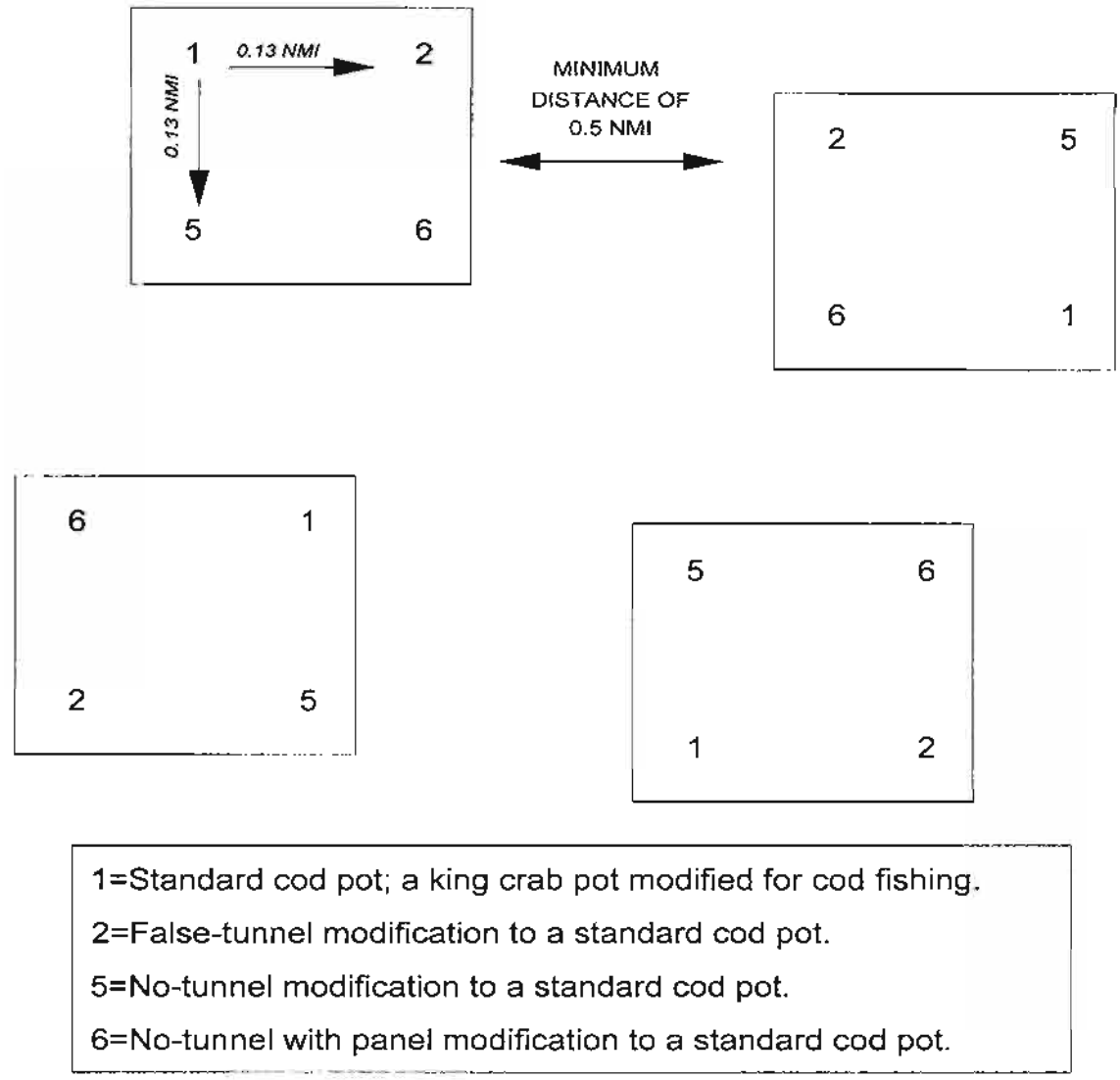

Figure 5. Sample pot deployment pattern showing placement of 16 pots. One of each pot type per quad is randomly placed approximately 0.13 nmi (0.24 km) apart. The quads are a minimum distance of 0.5 nmi (0.93 km) apart but can be laid out in any direction from each other.

APPENDIX

Appendix A. FY99 Yellow book allocation for the 1998 modified cod pot study.

PROJECT TITLE: Cod Pot Study
FISHERY UNIT: 4400 Interagency Receipts
COMPONENT CODE: 4001010700-Special Projects.
LOCATION: Kodiak

PROJECT NUMBER: SP-652
REGION: 4 Westward
LEDGER CODE: 11340231
LEGISLATIVE DISTRICT: 11,12

Project Description:
Pot gear accounts for a large and increasing portion of the Tanner crab bycatch in the Gulf of Alaska Pacific cod fishery. The need to develop crab-bycatch reduction measures in the cod pot fishery is indicated by the depressed status of affected crab stocks, the expected effort increases in the pot fishery, and provisions in the Magnuson-Stevens Fishery Conservation and Management Act that place increased emphasis on reduction of incidental catch. The Scientific and Statistical Committee of the North Pacific Fishery Management Council (NPFMC) has identified expanded research on gear modifications and other methods for reducing bycatch as the top research priority relative to bycatch problems. Testimony presented to the NPFMC in 1996 suggested that significant reductions in crab bycatch in the cod pot fishery could be effected by simple alterations to cod pots.

Project Objectives:
1. To solicit pot fishermen and pot manufacturers for cod pot alterations designed to reduce Tanner crab bycatch; 2. to test and compare the effectiveness of those alterations in reducing Tanner crab bycatch: and 3. to test and compare the effectiveness of those alterations in maintaining catch rates of Pacific cod.

BUDGET MANAGER: 11-1202 Douglas Pengilly Fishery Biologist IV

BUDGET DETAIL	FY96	FY97	FY98	FY99 Allocation
100 PERSONNEL SERVICES	22.9	32.5	44.4	12.6
200 TRAVEL		2.5	0.9	0.0
300 CONTRACTUAL		5.0	47.5	12.8
400 COMMODITIES		8.0	10.5	6.4
500 EQUIPMENT		5.0	0.0	0.0
PROJECT TOTALS	22.9	53.0	103.3	31.8
FEDERAL RECEIPTS	0.0	0.0	0.0	0.0
GENERAL FUND	0.0	0.0	0.0	0.0
INTERAGENCY RECEIPTS	0.0	0.0	0.0	0.0
PROGRAM RECEIPTS	22.9	0.0	0.0	0.0
FISH AND GAME FUND	0.0	0.0	103.3	31.8
CIP FUNDS	0.0	0.0	0.0	0.0
DPR FUNDS	0.0	53.0	0.0	0.0
STAFF MONTHS	5.0	5.0	9.0	1.1

-Continued-

Appendix A. (page 2 of 2).

PROJECT TITLE: Cod Pot Study
FISHERY UNIT: 4400 Interagency Receipts
COMPONENT CODE: 4001010700-Special Projects.

PROJECT NUMBER: SP-652
REGION: 4 Westward
LEDGER CODE: 11340231

PERSONNEL SERVICES DATA

PCN	RS	LOC	R&S	NAME	TITLE	MM	SEA	RDO	OT	HAZ	COST
11-1906	AS	CAA	11K	Dinnocenzo, T.	FWTIII	0	10	4	0	0	$2,236
11-1428	PS	CAA	14K	Watson, L.	FBI	1.1	10	4	5	0	$8,625
11-1603	PS	CAA	9D	Worton, C.	FWTII	0	10	4	0	0	$1,750
PERSONNEL TOTALS:						1.1	30	12	5		$12,611

PROJECT LINE ITEM DETAIL

LINE #	DESCRIPTION	COMMENTS	AMOUNT
73000	Charters/other		12.8
74000	Misc. Sci. Supply		6.4
TOTAL LINES 200-500:			19.2
		PROJECT TOTAL (in thousands):	31.8

Appendix B.1. Random pot order deployments by quad number and pot type for the October 1998 modified cod pot study in Chiniak Bay, Alaska. Pot types: 1=Standard cod pot; 2=False-tunnel modification; 5=No-tunnel modification; 6=No-tunnel with panel modification.

Quad	Pot Type Order			
No.	A	B	C	D
1	5	6	1	2
2	1	5	6	2
3	2	6	5	1
4	2	5	1	6
5	5	1	2	6
6	6	1	2	5
7	5	6	2	1
8	2	6	5	1
9	6	5	2	1
10	1	2	6	5
11	5	1	6	2
12	1	2	5	6
13	2	6	5	1
14	6	1	5	2
15	6	2	1	5
16	5	6	2	1
17	5	2	6	1
18	2	5	1	6
19	2	5	1	6
20	5	6	1	2
21	1	5	2	6
22	5	2	1	6
23	5	2	6	1
24	1	5	2	6
25	5	2	6	1
26	2	5	6	1
27	2	5	6	1
28	6	1	2	5
29	2	5	1	6
30	5	1	2	6
31	5	2	6	1
32	6	2	1	5
33	6	5	2	1
34	6	5	1	2
35	6	5	1	2
36	1	6	5	2
37	1	5	6	2
38	1	2	5	6
39	1	5	6	2
40	5	6	2	1
41	6	5	2	1
42	1	5	2	6
43	6	2	5	1

Quad	Pot Type Order			
No.	A	B	C	D
44	1	2	5	6
45	5	6	1	2
46	2	1	6	5
47	6	2	1	5
48	5	2	6	1
49	6	1	5	2
50	1	6	2	5
51	2	6	1	5
52	2	1	6	5
53	6	5	1	2
54	2	1	6	5
55	2	1	6	5
56	1	2	6	5
57	2	5	1	6
58	6	2	1	5
59	2	6	1	5
60	5	2	6	1
61	1	5	2	6
62	1	2	6	5
63	5	2	6	1
64	1	5	6	2
65	1	6	2	5
66	1	5	6	2
67	5	6	1	2
68	1	5	6	2
69	1	5	6	2
70	5	1	2	6
71	2	5	1	6
72	1	5	2	6
73	1	5	2	6
74	1	5	2	6
75	2	1	5	6

Appendix B.2. Random pot order deployments by quad number and pot type for the March 1999 modified cod pot study in Kupreanof Strait, Alaska. Pot types: 1=Standard cod pot; 2=False-tunnel modification; 5=No-tunnel modification; 6=No-tunnel with panel modification.

Quad	Pot Type Order			
No.	A	B	C	D
1	1	5	6	2
2	2	1	6	5
3	6	2	1	5
4	5	1	6	2
5	1	2	5	6
6	1	6	5	2
7	2	1	5	6
8	6	1	2	5
9	1	5	2	6
10	5	2	6	1
11	2	5	6	1
12	2	6	1	5
13	5	1	2	6
14	6	5	2	1
15	5	2	6	1
16	5	6	2	1
17	6	5	1	2
18	2	5	6	1
19	5	6	2	1
20	1	2	6	5
21	1	5	6	2
22	1	2	6	5
23	2	6	1	5
24	1	2	5	6
25	1	2	5	6
26	2	6	5	1
27	2	1	5	6
28	1	6	2	5
29	5	2	1	6
30	2	6	5	1
31	2	1	6	5
32	1	2	6	5
33	6	5	2	1
34	6	1	2	5
35	2	6	5	1
36	5	2	1	6
37	2	1	6	5
38	5	2	6	1
39	5	1	6	2
40	6	1	5	2
41	1	6	5	2
42	1	5	6	2
43	2	1	6	5

Quad	Pot Type Order			
No.	A	B	C	D
44	1	5	2	6
45	5	2	6	1
46	2	6	5	1
47	2	1	5	6
48	5	1	6	2
49	5	6	2	1
50	5	2	1	6
51	2	1	5	6
52	6	5	2	1
53	2	5	1	6
54	6	5	1	2
55	5	1	2	6
56	6	5	2	1
57	5	6	2	1
58	2	5	6	1
59	2	1	5	6
60	5	2	1	6
61	5	6	2	1
62	6	2	1	5
63	1	6	5	2
64	1	2	6	5
65	1	2	6	5
66	6	5	1	2
67	2	5	1	6
68	2	1	6	5
69	2	6	1	5
70	6	5	2	1
71	1	5	2	6
72	2	5	1	6
73	2	6	5	1
74	6	5	2	1
75	6	2	5	1

Appendix C.1. Pilot house log.

PILOT HOUSE LOG
MODIFIED COD POT STUDY

SEQUENTIAL POT NO	QUAD NO.	POT TYPE	SET GEAR			DEPTH (FMS)	BOT. TYPE	BUOY NO	LIFT GEAR			N. LATITUDE		W. LONGITUDE	
			MONTH	DAY	MILITARY TIME				MONTH	DAY	MILITARY TIME	DEGREES	MINUTES	DEGREES	MINUTES

POT TYPE
1: Standard Cod Pot
2: False Tunnel Ramp

BOTTOM TYPE
1: Rock
2: Sand
3: Silt
4: Mud

5: Flush Tunnel
6: Flush Tunnel w/Panel

LJW C:\PCOD97\SKIPFORM XLS
10/16/97

Appendix C.2. Species composition form.

ALASKA DEPARTMENT OF FISH AND GAME

MODIFIED COD POT STUDY-SPECIES COMPOSITION FORM

RECORDER: ____________________ PG ___ OF ___

SEQUENTIAL POT NO.	QUAD NO.	POT TYPE	SPECIES NAME	SPECIES CODE	LEG.	NO. IN POT	NO. RIDERS

ALASKA DEPARTMENT OF FISH AND GAME-CRAB DATA FORM

Appendix C.3. Crab data form. **MODIFIED POT COD STUDY** PG_____ OF _____

SPECIES _____ SEQ. POT NO. ___ ___ ___ SAMPLING

SEX _____ QUAD NO. ___ ___ FACTOR ___ ___ ___ / ___ ___ ___

DATE _____ POT TYPE ___ MEASURER _____

VESSEL _____ INSIDE (1)/OUTSIDE(2) ___ RECORDER _____

	SPECIES	SEX	SIZE (MM)			LEGAL	SHELL AGE	EMBRYOS				OTHER		COMMENTS
								COLOR	DEVEL.	CONDITION	% CLUTCH			
1														
2														
3														
4														
5														
6														
7														
8														
9														
10														
11														
12														
13														
14														
15														
16														
17														
18														
19														
20														
21														
22														
23														
24														
25														

Crab Species
1- L. aequispinus
2- P. camtschat.
6- C.bairdi
7- C. opilio
9- C. magister

Shell Age
0- New-Soft
1- New-Hard
2- Old
3- Very Old

Embryo Devel.
1- Uneyed
2- Eyed
3- Hatching

Clutch Condition
1- Dead embryos not apparent
2 -Dead embryos <20%
3- Dead embryos >20%

Other
1- Dead
2- Alive
3- Nemerteans in clutch
4- Turbellarians in clutch
5- Black mat
6- Bitter crab disease
7-"Cottage cheese" diseas
8-Shell rust
9-B. callosus

Sex
1- Male
2- Female

Legal
1-Subleg 3-Juvenile(fem)
2-Legal 4-Adult(fem)

Percent Clutch
1- Barren, clean pleopods
2- Barren with empty embryo cases & or stalks
3- Clutch 1-29% full
4- Clutch 30-59% full
5- Clutch 60-89% full
6- Clutch 90-100% full

POT TYPE: 1: **Standard Cod Pot** 2: **False Tunnel Ramp**
5: Flush Tunnel
6: Flush Tunnel w/Panel

ALASKA DEPARTMENT OF FISH AND GAME-FISH LENGTH FORM

Appendix C.4. Fish length form. **MODIFIED POT COD STUDY** PG______ OF ______

MEASURER ____________________ SAMPLING FACTOR [| | | | / | | |]

RECORDER ____________________ VESSEL

SEQ. POT NO.	P T	SPECIES NAME	SPECIES CODE	LENGTH (CM)	FREQ.	SEQ. POT NO.	P T	SPECIES NAME	SPECIES CODE	LENGTH (CM)	FREQ.

PT= POT TYPE: 1: Control Pot 2: Hanging Web Ramp
5: Flush Tunnel
6: Flush Tunnel w/Panel

Appendix D.1. Instructions for handling and operating the autonomous underwater video recorder system. (Source: D. Tracy, ADF&G- Kodiak, 10/98)

During programming of MSC-1000 controller, the spherical anodized aluminum housing containing this component and the system VCR must at all times be kept in a sheltered and dry area. **Under no circumstances will the housing be opened on the deck of the vessel - regardless of weather and sea conditions.** Since the system 24-volt battery must be re-charged following every deployment, the controller can most easily be accessed for programming by adhering to the following sequence of actions:

- Place the pot selected for observation in the vessel pot launcher.
- Secure the fully charged battery in the deployment frame.
- Secure the frame in the selected pot.
- Using the 40' auxiliary power cable and following Step # 1 below, connect the battery to the appropriate port (look for the matching pin pattern) on the housing end bulkhead.*

*Note: The power cables leading to the housing must be threaded through the open ends of orange "pumpkin" halves before they are attached to the housing ports. Otherwise, the housing cannot be properly secured in the pumpkin and deployment frame after programming is completed.

The housing can now be transported up to 40' to an indoor location where it can be opened and programmed. Prior to opening the housing following each deployment (and before disconnecting any of the power cables), it must be completely rinsed with FRESH WATER and subsequently dried off. Opening and closing the housing is accomplished by using the 110-volt two-directional air pump. To open the housing, place it in one of the white plastic buckets provided with the end bulkhead containing the hexagonal stainless steel pressure valve screw facing upward. Remove this screw and in its place attach the plastic pump hose leading to the arrow on the pump unit pointing outward (toward the free end of the hose you're attaching to the housing). **Before plugging in the pump make sure that a person is holding the upright half of the housing in place.** The over-pressurization of the housing necessary for opening it will cause the upper half to forcefully detach itself when the seal between the two halves is broken. After plugging in the pump, allow 5-10 seconds for over-pressurization to occur. To access the controller programming console and LCD, gently lift the detached half of the housing and place it in the second plastic bucket, while taking great care not to stretch, twist or tangle any of the internal wiring connecting the system components.

Programming the system controller can only be successfully completed by following the procedures outlined below:

1. If previously disconnected, before plugging in the battery camera and lights make sure the control toggle switch (the only toggle switch visible) is in the 'off' position.
2. Make sure VCR is turned off.
3. Turn control switch to the 'on' position.
4. The 1st menu screen on the controller LCD display, which is referred to as the 'standby screen', should read as follows:

RUN STORED PROGRAM
PROGRAM EVENTS
CALIBRATION

Sel Next Prev Back

a. Push the 'Next" button until you get to 'PROGRAM EVENTS'
b. Push the 'Sel' button

-Continued-

The 'PROGRAM EVENTS' menu screen should display the following:

EVENT: 1
DATE: 07 01 01*
TIME: 00:00:00
H M S
SEL NEXT PREV SAVE

*Note: The date will be displayed in the relative time mode (January 1, 1970); the controller can be programmed in the real or relative time mode. Programming in real time mode requires that the date and time be calibrated before hand to reflect the current time and date. Consult the complete MSC-1000 User's Manual for calibration procedures.

d. Push ' Next' until you advance to 'TIME'
e. Push the 'Sel' button, which will advance you to the 'Set Time' screen.

The 'Set Time' screen should display the following:

DATE TIME
YYMMDD HH:MM:SS

DIG. INC. DEC. BACK

f. Using the 'DIG.' key to advance between hours, minutes and seconds, and the 'INC.' and 'DEC.' keys to add or subtract units, enter the amount of time you want to elapse before the VCR and /or the camera lights come on (the internal programming clock will begin running as soon as a power source is connected to the controller).
g. press the 'SAVE' button.
h. press the 'NEXT' button, which will advance you to the 'Event Menu' screen.

The 'Event Menu' screen should display the following:
RECORD: AAA
CAMERA: AAA
LIGHT 1: AAA

SEL NEXT PREV BACK

i. Using the 'NEXT' and 'PREV' keys, toggle through between functions to activate the camera and lights. Press the 'SEL' key when the function you wish to change is highlighted (this will designate each accessory to come ON or OFF at the time of the event you have just programmed). In order to change the setting for the second camera light ('LIGHT 2') you must press the 'NEXT' button to scroll down the "Event Menu' screen. Use the "Sel' key to activate or de-activate the second light.
j. Press the 'BACK' button, which will return you to the 'PROGRAM EVENT' screen
k. Press the 'SAVE' button, which will return you to the 'Standby' screen ('EVENT 2' will now appear at the top of this screen).

IMPORTANT: You must repeat Step 4, parts a through j for each occasion you wish to program the video system to be turned on, or to be turned off. For example, if you wanted the recorder and camera (and if applicable, lights 1 and 2) to take video footage on two separate occasions during a given deployment time interval, you would need to program a total of 4 events - 1 for each time the system would come on (a total of 2 times in this example), and 1 for each time the system would shut off (twice in this example).

-Continued-

VERY IMPORTANT: After event programming has been completed, return to the 'Standby' screen and press 'RUN STORED PROGRAM', and then 'RUN'. After completing this step, the time you have remaining to successfully deploy the video system equals the difference between the time that has elapsed since you turned on the controller and the time until the first programmed event is to occur.

Programmed events cannot be stored in the controller memory (and thus will not occur at the specified date and time) if any steps in the sequence specified above are skipped. Therefore, it is imperative that for each deployment of the system, each programmed event is recorded on a step-by-step basis on the "Autonomous Underwater Video Recorder Event Sequence Worksheet" (Appendix B, Form #8).

The controller memory will accommodate a total of 183 events during a single programming cycle, which means that 91 separate time-lapsed intervals of video footage can be recorded during a single deployment of the system.

After programming has been completed, the housing must be closed and completely sealed by performing the following steps:

- Examine, clean and lubricate (using a small amount of electrical insulating compound) the housing O-rings and make sure they are seated properly around the male sealing bore.
- Apply a thin layer of lubricant on the female sealing bore.
- Being very careful not to twist or pinch any of the internal wiring, replace the top half of the housing by aligning the controller circuit board with the space in front of the VCR.
- Once the halves of the housing sphere are in alignment, re-inspect the O-ring seating placement and gently press the halves together until firm resistance is met.
- Attach the plastic hose leading to the arrow on the pump unit pointing inward (away from the end of the hose you're attaching to the housing) to the stainless steel pressure valve port.
- Plug in the pump until the vacuum created by air being removed from the housing draws the two halves completely together, and seals the bored surfaces with an audible suction sound.
- Replace the closure band around the housing (do not tighten excessively so that the shape of the band deforms).
- Replace the stainless steel pressure valve screw and gently tighten.

After securing the housing in the orange pumpkin using the PVC spacers, stainless steel bolts and wing nuts, fasten the pumpkin to the deployment frame in the appropriate position (as indicated by arrows and lettering on the frame). Mount the camera and lights (if applicable), keeping in mind that laterally, the lights should be approximately 28" from the camera, and must be set back slightly behind it in order to illuminate the entire area being filmed.

The system is now ready for deployment.

Appendix D.2. Autonomous underwater video recorder event sequence worksheet.

Project:	Deployment type:
Date:	Mode (circle one): real time relative time
Soak category (circle one): 12hr 24hr 72hr	Sequential pot number:
Operator(s):	

Event Number	Date	Time	Recorder on/off	Camera on/off	Light #1 on/off	Light #2 on/off	Elapsed Time	Comments